AOIT Computer Networking

Lesson 5

Network Components

Teacher Resources

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Teacher Resource 5.1

Answer Key: Network Infrastructure Analogy

Introduction to Network Infrastructure

The way a network is set up is called its *network infrastructure*, or *architecture*. Like a city full of different residents and modes of transportation, the network uses many different kinds of components to make sure that messages travel smoothly and quickly to their destinations.

The paragraphs below describe the roles of each main network component as if it were a person or an object in a city. Read each description and brainstorm with a partner to identify the main idea, and then describe the object’s main function using a few words or a short phrase.

* I am the town gossip. When I get information from one source on the network, I tell everyone else. One of my biggest weaknesses is that I’m illiterate, so I can’t read addresses. When I get a message, I can’t tell who it’s for, so that’s why I send it to everyone in the group.

**Description**: Broadcasts messages to everyone

* My name is Nic, and I am an intelligent citizen and homeowner. I have my own address that no one else shares, and any time I send and receive messages, they are stamped with this address.

**Description**: Sends and receives messages to and from a unique address

* I am one of the city’s pet parrots. City officials can’t yell loud enough to hear each other on opposite sides of the room, so the parrots sit between desks and repeat the messages very loudly. I’m not smart enough to know what the words mean, but I can mimic the message very well, so the officials can communicate.

**Description**: Repeats messages across distances

* I am the postal worker you trust to deliver your letters and bills. Like the town gossip, I know everything that goes on, but I’m smart enough to read addresses, organize messages, and send messages only to the right people.

**Description**: Delivers messages to the right addresses

* I’m the guard at the gate of the city. When we get visitors, I can check their passports and IDs to make sure they’re allowed inside and send them to the places they’re trying to go. When townspeople want to leave, I tell them the fastest way to the next place they’re going.

**Description**: Supervises messages coming into or leaving the city

* I’m a city guard who can also translate different languages. When new messages in foreign languages come in, I translate them so that the people in the city don’t have to worry about understanding many languages and customs.

**Description***:* Translates messages from different languages

Teacher Resource 5.2

Guide: Network Components Descriptions

After students read the analogies in Student Resource 5.1, Worksheet: Network Infrastructure Analogy, tell them a bit about each of the network components below, and ask them to identify which analogy matches the component.

Network Interface Card (NIC)

A *network card* that plugs into your computer, the NIC is a circuit board that allows you to plug in an Ethernet cable and connect your computer to a network or the Internet. Every interface card has its own unique MAC (Media Access Control) address that distinguishes it from all other devices on the network and on the Internet. Internet Protocol (IP) addresses are assigned by software and can change, but the interface card’s address is forever assigned to its hardware.

Repeater

*Repeaters*, as their name implies, simply repeat a message. They are used in networks that need to send messages across longer distances than the wires themselves can carry the message. So, installing a repeater along the way, between two cables, prevents the message from getting weak and allows it to reach the final destination. Repeaters can’t read addresses or data, but they can regenerate a weakened signal. Repeaters are often used in transcontinental and submarine communications cables, because the attenuation (signal loss) over such distances would be unacceptable without them. Repeaters are used in both copper-wire cables carrying electrical signals and in fiber optics carrying light. In Ethernet networks, hubs are used as multiport repeaters.

Hub

*Hubs* connect a few computers on a local area Ethernet network. They do not read MAC addresses, so they send data packets to all the computers on the network. The computers then read the addresses on the data packets, collect messages directed to them, and reassemble them as directed. (Hubs for the most part have been replaced by switches.)

Switch

*Switches* are smarter versions of hubs and can read the MAC addresses attached to data packets. Rather than broadcasting messages to every computer on the network, switches send data packets only to the computer they’re intended for. Like hubs, switches have multiple ports for computers to plug into—but because they do not slow down the network with extra, unnecessary broadcasts, switches can be used to join more than just a few computers. Many businesses connect all the computers on their network through one or more central switches.

Router

*Routers* are the *outers*, the components that sit at the edge of a local network and connect it with the larger Internet. They have the ability to read the IP addresses on data packets, and they can also look inside a message that gets sent across the network to see what kind of message it is. Routers direct incoming messages to the right computer and direct outgoing messages to the fastest route to their destination.

Gateway

*Gateways* are intelligent routers that sit at the edge of a network. They have all of the abilities of a router, plus they can translate between network protocols. Since each network can use only one sort of protocol, gateways are used to connect two networks that are running different protocols.

Teacher Resource 5.3

Answer Key: Network Components Puzzle

The following puzzle is filled with the analogies between a city and a network and shows how the residents of a city parallel network components.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **The Component/Person** | **Shared Function** | **The Place** |
| 1 | A network interface card | Uses a unique address | On the network |
| A citizen | In the town |
| 2 | A hub | Broadcasts news to everyone | In the local area network |
| A town gossip | In his neighborhood |
| 3 | A repeater | Repeats a signal | Across cables |
| A city parrot | Across the room |
| 4 | A switch | Delivers messages to a specific address | In the local area network |
| A postal worker | In the city |
| 5 | A router | Supervises incoming and outgoing messages | At the edge of the local area network |
| A city guard | At the city edge |
| 6 | A gateway | Translates messages | Between networks using different protocols |
| A city translator | Coming into the city from other cities |

Teacher Resource 5.4

Answer Key: Scavenger Hunt

The following network components are all used to connect computers on a network, but each performs a slightly different function and serves a different need.

| Network component | What does it look like? How does it connect cables and computers? | What is its main function? | How intelligent is it, or what other features does it have? | |
| --- | --- | --- | --- | --- |
| **Network interface card** | Circuit board attached inside computer. Has one Ethernet port that allows user to plug in a twisted-pair cable to connect to the network. | Allows one computer to connect to a network via the Ethernet port; offers the network a unique address. | Has its own physical, unique network address, called a MAC address. | |
| **Repeater** | Small device that links two cables together. | Reconstructs, regenerates, or amplifies a signal to make up for signal degradation across long distances. Used when the distance is too far for one cable to traverse. | Can’t interpret the signal or understand the addresses or packet contents; it just boosts the signal. | |
| **Hub** | A small box that, used with Ethernet cable, joins computers on a local area network. Usually has 4 to 25 ports for local computers. | Allows several computers to connect on the same local network. Broadcasts messages to all computers on that network until one recognizes and accepts the signal. Benefit is its low cost; drawback is that the network can be slow with too many computers attached, and the mass broadcast reduces security on the network, since signals can be picked up by all other computers. | Doesn’t understand the MAC addresses of computers, so it just sends the messages to all of them, which can slow down the network and create security problems. Also is used as a multiport repeater for Ethernet networks using UTP cables. | |
| **Switch** | A device that can join many computers on a local area network, to enable local file sharing and/or Internet access. Can have from four ports to hundreds of ports (stackable switches). | Used to connect computers for file sharing and Internet access. Recognizes the MAC addresses of local computers’ network interface cards and sends messages only to the computer designated as recipient. | Has largely replaced the hub because it recognizes MAC addresses. Switches are the “smarter” devices. Can be relatively inexpensive for small installations, or large and expensive for businesses. |
| **Router** | Sits on the boundary between the Internet and the local area network or is used to segment large local area networks into smaller segments. | Inspects incoming and outgoing packets and directs them toward the fastest route to the destination. | Can read message contents as well as IP and MAC addresses and throw out, alter, or direct messages accordingly (activities known as stateful packet inspection and packet filtering and routing). |
| **Gateway** | Sits on the boundaries between networks that use different network protocols; e.g., Internet Protocol, NetBIOS, NetBEUI, SPX/IPX, or AppleTalk. | Same as a router but also translates messages between differing network protocols so that two networks using different protocols can still communicate. | Has the same capabilities as a router but also reads multiple protocols. |

Teacher Resource 5.5

Answer Key: Network Scenarios

Ask students to read each scenario and write which of the following network components would most appropriately solve the network problem described.

|  |  |  |
| --- | --- | --- |
| * Repeater/booster | * Hub | * Switch |
| * Gateway | * Router |  |

Scenario 1

You are the new IT person for a small charter school that has a new computer lab. The lab has 30 desktop computers, and students will be working separately on these computers. They are expected to perform Internet research, watch videos, and check their email.

How will you connect computers so that they all have a speedy Internet connection?

ANSWER: Switches (probably multiple switches connected to the main switch)

Scenario 2

You are a college student setting up a home network for yourself and your housemates. You want to be able to share files among five computers and allow all computers to access the Internet. You also want to be sure that you have network security precautions, such as a firewall, in place.

Which component will you install so that you can share files and access the Internet, yet protect your home computers?

ANSWER: Router

Scenario 3

You live far up in the mountains and can’t get a regular Internet service provider to run cable up to serve your area. You and your neighbor have decided that the best way to get Internet access is to share the cost of a satellite Internet connection. However, this involves running cables from your house, where the satellite is, to your neighbor’s house. Your major problem is that the distance between your houses is longer than the maximum length that an Ethernet cable can carry a signal. If you run such a long cable, the signal will get weak (degrade or attenuate), and your neighbor won’t be able to send and receive data.

Which network component will you use to make sure the signal clearly reaches your neighbor’s house?

ANSWER: Repeater/booster

Scenario 4

You are setting up a small local area network in your home so that you can share some family photos and school assignments with your parents. You want to be able to hook up your parents’ computer, your computer, and your little sister’s computer to the network all at the same time. Your parents don’t want to spend a lot of money, either.

Which component will best hook up all three computers to let you share some files, but not cost much?

ANSWER: Hub

Scenario 5

You are the new IT manager for a medium-sized company that has some old, legacy computer systems as well as new, state-of-the-art systems. The new systems use the IP standard to communicate, but the old systems use different protocols such as AppleTalk, which was used on old Macintosh computers.

Which component can you install that can translate between all these different computer languages and allow your computers to communicate?

ANSWER: Gateway

Teacher Resource 5.6

Assessment Criteria: Network Components Poster and Presentation

Student Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

Using the following criteria, assess whether the students met each one.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Met | Partially Met | Didn’t Meet |
| The poster features an accurate visual representation of the component and shows how it connects computers. |  | □ | □ | □ |
| The poster’s text accurately describes what this network component does. |  | □ | □ | □ |
| The poster’s text accurately lists the advantages and disadvantages of the network component. |  | □ | □ | □ |
| The poster is neat and presentable. All text is legible, with proper spelling and grammar. |  | □ | □ | □ |
| All content in the presentation is accurate and complete and communicates an understanding of the topic. |  | □ | □ | □ |
| All of the material in the presentation is relevant to the topic of the presentation. |  | □ | □ | □ |
| The presentation is at the appropriate volume and speed and has no mispronunciations. |  | □ | □ | □ |
| The presentation is prepared and rehearsed; all group members who present know their part. |  | □ | □ | □ |
| The question/answer session following the presentation shows knowledge of the component presented. |  | □ | □ | □ |

Additional Comments:

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Teacher Resource 5.7

Key Vocabulary: Network Components

These are terms to be introduced or reinforced in this lesson.

| Term | Definition |
| --- | --- |
| filter | To inspect packets and route messages based on the address or contents of the data. |
| gateway | A network component that links two or more computer networks and can translate between network protocols. |
| hub | A device used to connect several computers. The central component, which sends incoming messages to all other devices on the network, usually has from 4 to 24 ports. |
| local area network | A network that links computers and peripheral equipment within a limited area, such as a building or a group of buildings. |
| network architecture | The design of a network setup, including computers, cabling, and components; it can be visually illustrated in a network diagram. |
| network component | Device used to route traffic along a network and convey digital communications signals. |
| network interface card (NIC) | An adapter card in a computer that enables the computer to attach to a network cable. |
| port | A connector on the back of a computer where you can plug in a device such as an Ethernet cable, a mouse, or a printer. |
| repeater | A network component that amplifies and regenerates a digital signal so that the signal can travel further. |
| router | A device that links two computer networks or links a local area network to the Internet. Reads packet addresses and routes packets. |
| segment | A section of a local network. Networks may be segmented to increase the speed of communications or the security of confidential information being stored on one segment of the network. |
| switch | Used to connect several computers; a central component that can send messages to specific addresses based on MAC addresses. An entire small business may connect through one switch. |

Teacher Resource 5.8

Bibliography: Network Components

The following sources were used in the preparation of this lesson and may be useful to you as classroom resources. We check and update the URLs annually to ensure that they continue to be useful.

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